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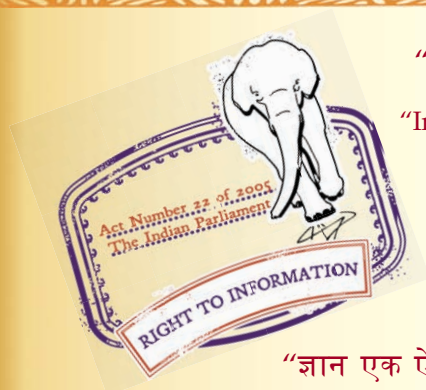
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IS 8790-1 (1978): General requirements of powered industrial trucks working in hazardous areas, Part 1
Internal combustion engines-powered trucks [TED 22:
Transport Tractors and Trailers]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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IS : 8790 (Part I) - 1978

Indian Standard

GENERAL REQUIREMENTS OF POWERED
INDUSTRIAL TRUCKS WORKING IN
HAZARDOUS AREAS

PART I INTERNAL COMBUSTION ENGINE-
POWERED TRUCKS

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NEW DELHI 110002

Indian Standard

GENERAL REQUIREMENTS OF POWERED INDUSTRIAL TRUCKS WORKING IN HAZARDOUS AREAS

PART I INTERNAL COMBUSTION ENGINE- POWERED TRUCKS

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Indian Standard

GENERAL REQUIREMENTS OF POWERED INDUSTRIAL TRUCKS WORKING IN HAZARDOUS AREAS

PART I INTERNAL COMBUSTION ENGINE- POWERED TRUCKS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 28 April 1978, after the draft finalized by the Industrial Trucks Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

0.2 Safety in Industrial operations is of extreme importance in order to avoid loss of human life or equipment and as incentive to the workmen involved in these operations. As more and more industrial trucks are used for load movement in industries with potentially hazardous atmospheres there is a need for guidelines for the economization in risks involved not only in the design and manufacture or conversion of trucks, but also for their operation and maintenance. It is difficult to make all areas absolutely free of hazardous atmosphere but it is possible and may be more economical to devise means to ensure a safe operation for the industrial trucks in hazardous atmospheres.

0.3 Industrial trucks may be powered with an electric battery or internal combustion engine. Therefore this standard is issued in the following two parts:

- a) Part I Internal combustion engine-powered trucks, and
- b) Part II Electric battery powered industrial trucks.

0.4 The areas where the hazardous handling operation occur can be identified with the works and stores dealing with explosives and petroleum based products, motor spirits, plastics, petro-chemicals, paints, cosmetics, LPG, besides oil refineries, airport refilling zones, oil and gas exploration and production rigs, artificial fibre plants, dye works, fertilizer plants, mines and many chemical works.

0.5 The hazard factor in terms of fire and/or explosive risk to the personnel and property depends upon the presence of air/gas, vapour or powder mixture present in critical proportion which, if ignited by hot surface, hot gases, flame or sparks could cause an explosion or conflagration.

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0.6 The question of truck operation in hazardous environment must go farther than the approved designs of the machine. The safety of the total environment must be considered, namely, air circulation, ventilation, layout, types of flooring, presence of ramps and other equipment, etc, as also the question of maintaining the flame-proofed trucks.

0.7 Efforts have been made to ensure provision of the legislation in safety in the operation of industrial trucks in the hazardous areas as applicable to individual industries. No comprehensive guidelines have been in existence.

0.8 Wherever any requirement has been stipulated by statutory order, the same shall prevail over the requirement under this standard.

0.9 In the preparation of this standard, assistance has been derived from the following:

BS CP 1003 : Part I : 1964 Electrical apparatus and associated equipment for use in explosive atmospheres of gas or vapour other than mining applications, Part I Choice, installation and maintenance of flame-proof and intrinsically-safe equipment. British Standards Institution, UK.

ANSI B56.4-1972 Standard for safety industrial trucks, internal combustion engine-powered. Underwriters' Laboratories, USA.

NFPA 505-1975 Fire safety standard for powered industrial trucks, including type designations and areas of use. National Fire Protection Association, USA.

1. SCOPE

1.1 This standard (Part I) covers construction and maintenance requirements of internal combustion engine-powered trucks with regard to their fire hazard aspects. The requirements with regard to other possible hazard aspects of such equipment are not covered in this standard.

1.1.1 This standard applies to forklift trucks, tractors, platform trucks and other specialized industrial trucks powered by internal combustion engines but does not apply to the industrial trucks powered by compressed air or nonflammable gas and farm or road vehicles or automotive vehicles for use on highways.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Hazardous Atmosphere — An atmosphere containing any flammable gas or vapour in a concentration capable of ignition.

2.2 Hazardous Area — An area where, during normal operations, a hazardous atmosphere is likely to occur in sufficient quantity to constitute a hazard.

2.3 Remotely Hazardous Area — An area, excluding an oil field, in which any flammable liquid, gas or vapour, although processed, handled or stored, is so well under conditions of control that its probability to produce a hazardous atmosphere in sufficient quantity to constitute a hazard is only likely to occur under abnormal conditions.

2.4 Safe Atmosphere — An atmosphere not falling within the definition of hazardous atmosphere and incapable of ignition.

2.5 Safe Area — An area no part of which lies within either a hazardous area or a remotely hazardous area.

3. IDENTIFICATION OF INDUSTRIAL TRUCKS

3.0 For the purpose of this standard, the industrial trucks shall be designated as under depending upon the type.

3.1 Types G, D and LP — Industrial trucks fuelled with petrol (G), diesel (D) and LPG (LP) having fuel, electrical and exhaust systems provided with minimum acceptable safeguards against fire hazards.

3.2 Types GS, DS and LPS — Industrial trucks fuelled with petrol (GS), diesel (DS) and LPG (LPS) having fuel, electrical and exhaust systems provided with safeguards in addition to those required for Types G, D and LP respectively.

4. CLASSIFICATION OF HAZARDOUS AREAS

4.1 In determining the risk of fire or explosion from the presence of flammable liquids, gases or vapours, the zones with such characteristics have been divided into the following three categories according to the degree of probability of the presence of hazardous atmosphere.

4.1.1 *Zone 0 Areas*

4.1.1.1 An areas in which hazardous atmosphere is continuously present shall fall under this category. This classification is applicable only where it is expected that a hazardous atmosphere will exist continuously. The statistical average duration for which the hazardous atmosphere is present is more than 1000 hours per annum.

4.1.1.2 Since a hazardous atmosphere exists continuously, any failure of electrical apparatus installed in a Zone 0 area would almost certainly lead to fire or explosion. Therefore, any installed electrical apparatus shall afford a degree of protection as near as practicable to the absolute.

4.1.2 Zone 1 Areas — An area in which a hazardous atmosphere is likely to occur under normal operating conditions shall fall under this category. This classification is applied to areas in which a hazardous atmosphere is likely to occur at any time, and which, therefore, require the fullest practicable application of measures to prevent the occurrence of a hazardous condition at any time and in any circumstances. The statistical average duration for which the hazardous atmosphere is present is between 10 hours and 1 000 hours per annum.

4.1.3 Zone 2 Areas — An area in which a hazardous atmosphere is likely to occur only under abnormal operating conditions shall fall under this category. This classification is applicable only where a fire or explosion hazard is unlikely and may be caused only by the simultaneous and improbable occurrence of an arc or spark resulting from an electrical failure and a hazardous atmosphere arising through failure of the conditions of control. It presupposes that any hazardous atmosphere resulting from an abnormal occurrence is rapidly dispersed so that possible contact with the electrical apparatus is of minimum duration. Any situation which allows a hazardous atmosphere to collect, such as pit or trench, although, it may be in the open air, shall in itself be classified as Zone 1 area, even though the surrounding area is classified as Zone 2. The statistical average duration for which the hazardous atmosphere is present is less than 10 hours per annum.

4.2 The three basic conditions which are to be satisfied for the occurrence of fire or explosion are as under:

- a) Presence in sufficient quantity of a flammable gas or vapour;
- b) Mixing of the flammable gas or vapour with air or oxygen in proportions required to produce an explosive or ignitable mixture; and
- c) Occurrence of ignition.

4.2.1 In applying this principle to any potential hazard, the quantity of the substance that might be liberated, its physical characteristics and the natural tendency of vapours to disperse in the atmosphere shall be recognized.

4.3 In the case of internal combustion engine-powered truck, the flammable gas in the atmosphere, in which it is operated, on being sucked into the engines may cause over-speeding and damage is likely to occur to both men and materials.

5. CONSTRUCTION — TYPES G, D AND LP

5.1 Electrical System

5.1.1 The electrical system shall be based on double-pole wiring, that is, earth return shall not be employed.

5.1.2 Wherever applicable, the electrical equipment used shall generally be enclosed in flameproof enclosures conforming to IS : 2148-1968*.

5.1.3 Wires and cables shall be installed so as to minimize chafing of insulation. Acceptable provisions may include the use of clamps, grommets, loom, sleeves, supplementary insulation, conduit, and routing.

5.1.4 Wiring mounted on booms, lifts, and similar parts subject to motion relative to other parts to which the wiring is connected, shall not be subject to damage or failure as the result of bending, kinking, abrasion, etc.

5.1.5 Wiring and cables shall be installed with means for maintaining clearance from moving parts, hot engine parts, exhaust systems, and fuel systems and shall not be supported on surfaces that may be subjected to accumulation of oil or grease as a result of normal servicing.

5.1.6 Wiring and cables shall not be exposed to drippage of fuel, oil, or grease and shall not be supported on oil or grease-retaining surfaces.

5.1.7 If an audible electrical warning device is employed, its coil and other electrical parts shall be enclosed in metal, or by an equivalent material. Among the factors which shall be taken into consideration when judging the equivalence of a non-metallic enclosure are: (a) the mechanical strength, (b) resistance to impact, (c) moisture-absorptive properties, (d) combustibility, and (e) resistance to distortion at temperatures to which the material may be subjected under conditions of normal or abnormal usage.

5.1.8 Each lighting and warning-device circuit shall be protected by a fuse or a circuit breaker rated to protect against hazard due to short or grounded circuit. A fuse conforming to IS : 2086-1973† shall be acceptable.

*Specification for flameproof enclosures of electrical apparatus (*first revision*).

†Specification for carriers and bases used in rewirable type electric fuses up to 650 volts (*revised*).

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5.1.9 A chain shall be hung from the vehicle for earthing purposes.

NOTE — Some of the standards which are relevant in this context are as follows:

- a) IS : 5571-1970 Guide for selection of electrical equipment for hazardous areas;
- b) IS : 5780-1970 Intrinsically safe electrical apparatus and circuits; and
- c) IS : 6381-1972 Construction and testing of electrical apparatus with type of protection 'e'.

5.2 Exhaust Systems

5.2.1 The exhaust system, beyond the manifold, shall be supported at least 75 mm clear of combustible materials, excluding flexible mountings and at least 50 mm clear of fuel and electrical-system parts and shall not be subjected to drippage of fuel, oil, or grease.

5.2.2 A flame-trap (spark arrester) made of a double layer mesh of corrosion-resistant metal not less than 10 per cm shall be provided.

5.2.3 A muffler shall be provided conforming to Indian Standard Performance tests for industrial truck (internal-combustion engine powered) (*under preparation*).

NOTE — Until the standard under preparation is published the matter shall be subject to agreement between the concerned parties.

5.3 Fuel Systems — Petrol and Diesel

5.3.1 Tanks and Pumps

5.3.1.1 A fuel tank shall be constructed of painted mild steel having a minimum thickness of 0.8 mm or material equivalent in strength, rigidity, and resistance to fire and corrosion. The joints shall be welded, brazed, soldered, or bonded. If soldered or bonded, the joints shall be of a construction which will retain the heads if the solder or bonding melts. Fittings and fill pipe, if soldered or bonded, shall be mechanically secured to the tank in addition to soldering or bonding.

5.3.1.2 A fuel tank shall not be located directly over the engine. If a tank is within or contiguous to the engine compartment, the tank and/or fill arrangement shall be isolated from the electrical and exhaust systems by a separate enclosure or by baffles. The tank location and the facilities for filling shall be such that spillage or leakage will drain to the ground and not into the engine compartment or onto electrical or exhaust-system parts. Spillage tests shall be conducted, if necessary, to determine compliance with the intent of the foregoing requirements.

5.3.1.3 A fuel tank and fill fitting shall be so located as to minimize the possibility of damage to the tank or its fittings.

5.3.1.4 External fuel-confining parts of an electrically or mechanically operated fuel pump shall be of metal. Failure of operating parts shall not result in external leakage of fuel.

5.3.1.5 A shut-off valve shall be provided in an accessible location near the tank on gravity-feed systems or on systems where the contents of the tank may discharge by siphon action, if the fuel line breaks.

5.3.2 *Fuel Lines and Fittings*

5.3.2.1 Fuel lines, except those used in a high pressure injection system, shall be of seamless annealed copper or steel tubing. Flexible tubing or hose shall be used, where necessary, to absorb vibration.

5.3.2.2 Copper tubing shall have a nominal wall thickness of not less than $0.875 \pm_{0.075}^0$ mm. Steel tubing shall have a wall thickness of not less than 0.7 mm and a corrosion-resistant exterior coating.

5.3.2.3 A body or fitting provided with tapered threads shall be threaded in accordance with IS : 2643-1964*.

5.3.2.4 External fuel-confining parts of a filter, except a gasket or seal, shall be of metal.

5.3.2.5 Fuel lines shall be supported to minimize chafing and to maintain at least 20 mm clearance from exhaust and electrical-system parts.

5.3.2.6 Fuel feed lines, valves, and fittings shall be located so that any leakage will not run off or drip on electrical or exhaust-system parts.

5.3.3 *Corrosion Resistance*

5.3.3.1 If corrosion of a ferrous part interferes with the proper functioning of a part, the part shall be provided with a corrosion-resistant protective coating.

5.3.3.2 A part made of drawn brass or machined from brass rod shall be capable of withstanding, without cracking, the mercurous-nitrate test for copper and copper alloys.

5.3.4 *Carburettors*

5.3.4.1 An updraft carburettor, if used, shall be located so that overflow of petrol due to excess choking will flow to ground and not contact electrical parts and exhaust system, or collect in an engine compartment.

*Dimensions for pipe threads for fastening purposes.

5.3.4.2 A downdraft carburettor, if used, having an external float bowl vent opening, shall have a vent overflow tube to direct fuel away from the engine in case of fuel overflow.

5.3.4.3 A backfire deflector shall be provided on each combustion air intake and, may be separate or a part of an air cleaner.

6. CONSTRUCTION — TYPES GS, DS AND LPS

6.1 Electrical Systems — The electrical system shall comply with **5.1.1**, **5.1.4**, **5.1.5** and **5.1.6** with the following additions.

6.1.1 Wiring terminals shall be protected by insulating boots or covers, unless they are intentionally connected to ground on the truck frame when the truck is in operating condition.

6.1.2 A generator, alternator, motor, or relay shall be totally enclosed.

6.1.3 A manual disconnect switch readily reached by the operator shall be installed in the battery and charging circuits to permit quick disconnect in case of an electrical disturbance.

6.2 Exhaust Systems — The exhaust system shall comply with the following requirements in addition to those of **5.2**.

6.2.1 The exhaust piping shall be formed of material having strength, rigidity, and resistance to corrosion and fire equivalent to mild steel tubing having a minimum thickness of 1.32 mm.

6.2.2 The muffler shall be of welded steel construction, using material having a minimum thickness of 1.32 mm.

6.3 Fuel Systems — Petrol and Diesel — The fuel system shall comply with **5.3** with the following exceptions and additions.

6.3.1 A fuel tank shall be constructed of painted mild steel having a minimum thickness of 1.32 mm or material equivalent in strength, rigidity, and resistance to fire and corrosion. The joints shall be welded, brazed, soldered, or bonded. If soldered or bonded, the joints shall be of a construction which will retain the heads if the solder or bonding melts. Fittings and fill pipe, if soldered or bonded, shall be mechanically secured to the tank in addition to soldering or bonding.

6.3.2 The fuel tank shall have sufficient capacity for eight hours of operation or shall have a reserve fuel supply valved from the main tank for emergency operation.

6.3.3 A hand priming pump, or equivalent, shall be provided on a Type DS truck to assure delivery of fuel to the injector pump when restarting after the fuel supply has been exhausted.

6.3.4 A self-closing type fill and vent fitting shall be provided. A fuel gauge or low-level indicator visible to the operator shall be provided. It is recommended that an overflow warning signal be employed.

7. CONSTRUCTION — AUTOMOTIVE TYPE COMPONENTS

7.1 Electrically Operated Fuel Pumps

7.1.1 An electrically operated fuel pump shall be provided with a mounting bracket, or provision for mounting bolts shall be an integral part of the assembly.

7.1.2 The outer enclosure of the pump shall be of metal. All case and component materials which are not inherently resistant to corrosion shall be plated with cadmium having a thickness of not less than 0.0075 mm or zinc having a thickness of not less than 0.0125 mm.

7.1.3 The fuel containing portion of the pump shall be separated from the electrical compartment or components, employing metal partitions secured and sealed using soldered, welded, or brazed joints, or the pump assembly shall conform to the requirements of the explosion test.

7.1.4 Vent holes may be provided for the electrical enclosure if the fuel-containing portion of the pump is separated from the electrical compartment as described in 7.1.3.

8. PERFORMANCE

8.1 The performance of the various equipment and automation type components shall be as prescribed in Indian Standard Performance tests for industrial truck (internal-combustion engine powered) (*under preparation*).

NOTE — Until the standard under preparation is published the matter shall be subject to agreement between the concerned parties.

9. MAINTENANCE OF INDUSTRIAL TRUCKS

9.1 General — It is essential that the fire safety built into power-operated industrial trucks be maintained; any power-operated industrial truck not in safe operating condition shall be removed from service.

9.2 Precautions — Repairs shall not be made in hazardous area falling under Zones 0, 1 and 2.

9.3 All parts of any industrial truck requiring replacement shall be replaced only with parts providing the same degree of fire safety as those used in the original design.

9.4 Water mufflers shall be filled daily or as frequently as is necessary to prevent depletion of the supply of water below 75 percent of the filled capacity. Vehicles with mufflers having screens or other parts that may become clogged shall not be operated while such screens or parts are clogged. Any vehicle that emits hazardous sparks or flames from the exhaust system shall immediately be removed from service, and not returned to service until the cause for the emission of such sparks and flames has been eliminated.

9.5 When the temperature of any part of any truck is found to be in excess of its normal operating temperature and which creates a hazardous condition, the vehicle shall be removed from service and not returned to service until the cause for such overheating has been eliminated.

9.6 Industrial trucks shall be kept in a clean condition, reasonably free of lint, excess oil, and grease. Non-combustible agents are preferred for cleaning trucks. Precautions regarding toxicity, ventilation and fire hazard shall be in consonance with the agent or solvent used.

9.7 When antifreeze is required in the engine cooling system, only glycol base material shall be used.

9.8 Industrial trucks originally approved and classified:

- a) for the use of petrol as fuel may be converted to liquefied petroleum gas as a fuel;
- b) for the use of petrol or liquefied petroleum gas as fuel may be converted to dual-fuel;
- c) for the use of liquefied petroleum gas as fuel or dual-fuel may be converted to petrol as a fuel;
- d) for the use of dual-fuel may be converted to liquefied petroleum gas as a fuel, provided the complete conversion results in a truck which embodies the features specified for the particular fuel to be used; and
- e) installation directions shall be furnished with the conversion equipment and shall detail how to make the conversion, so the converted truck will embody all the necessary features to meet the desired type designation given in this standard.

10. MARKING

10.1 General

10.1.1 Each industrial truck shall be marked, where it is visible, with the following:

- a) The manufacturer's or purchaser's identification;

- b) The type designation (Type G, D, LP, GS, DS and LPS); and
- c) A distinctive model, catalogue or equivalent designation.

10.1.2 Each electrical-component assembly, such as a switch or an electric fuel pump, shall be marked with the following:

- a) The manufacturer's or purchaser's identification;
- b) A distinctive model or equivalent identification;
- c) The electrical ratings applicable to motors, switch gear, windings, etc; and
- d) The capacity and pressure ratings for fuel pumps.

10.1.3 If a manufacturer produces industrial trucks at more than one factory, each truck shall have a distinctive marking to identify it as the product of a particular factory.

INDIAN STANDARDS
ON
INDUSTRIAL TRUCKS

IS:

- 4357-1974 Methods for stability testing of fork lift trucks (*first revision*)
- 4660-1974 Glossary of terms relating to powered industrial trucks (*first revision*)
- 5008-1969 Data sheet for industrial tractors
- 6305 (Part I)-1971 Safety code for powered industrial trucks: Part I Operation and maintenance
- 6305 Part II)-1972 Safety code for powered industrial trucks: Part II Manufacture
- 6765-1972 Rated capacity of counterbalanced fork lift trucks
- 6876-1972 Technical characteristics and testing of fork arms for fork lift trucks
- 7217-1974 Nomenclature of power operated or towed industrial trucks and trailers
- 7309-1973 Stability tests for reach and straddle fork lift trucks
- 7496-1974 Direction of travel controls
- 7525-1974 Mounting dimensions for fork carriers and fork arms for fork lift trucks
- 7552-1974 Stability tests for trucks operating in special conditions
- 7553-1975 Control symbols for powered industrial trucks
- 7570-1975 Glossary of terms relating to fork arms and attachments of fork lift trucks
- 7617-1974 Code of practice for maintenance of forks for fork lift trucks
- 7621-1974 Tests for overhead guards for powered industrial trucks
- 7631-1975 Stability tests for pallet stackers and high lift platform trucks (pedestrian and rider controlled)
- 7862-1975 Glossary of terms relating to safety aspects concerning operating areas of industrial trucks